A decade of unprecedented growth
China’s impact on the semiconductor industry
2014 update
Introduction

For this, our 2014 update to our annual report, China’s impact on the semiconductor industry, we have once again elected to release the report in sections in order to provide the information to you as early in the year as possible. Our regular readers should note that all of the considerations described in the 2012 Update appendix, “Interpreting Chinese semiconductor statistics” and the “About this report” sections remain relevant to this update and should be referred to as needed. They may be updated as appropriate with the final release of this year’s report. These documents, as well as all of our previously issued reports, are available at our website at www.pwc.com/chinasemicon.

This, the second of three releases for 2014, contains the following sections:

- IC design in China
- Chinese semiconductor companies
- Interview—NXP
- Wafer fabrication capacity
- Interview—JCET
- Packaging, assembly and test capacity
- Regional structure
- Conclusion

Please note that numbering of figures and tables are continuous through each release. Thus, this section begins with Figure 13 and Table 4.

The first release of this year’s report provided a market and industry overview. It can be found at www.pwc.com/chinasemicon. Our third and final release will cover China’s domestic OEM buying power, the top Chinese semiconductor manufacturers, the greater China market, semiconductor patents and IPOs, government incentives and growth scenarios. A final report, featuring an executive summary, updated statistics (if any of the data has changed over the months) and an overall conclusion, will be available toward the end of the year. Any revisions to text or data that become necessary due to new data or information will be reflected in the pdf file on our website and in the final report. We may also revise the appendix sections (“About this report” and “Interpreting Chinese statistics”) at this time as well.

Individual sections, the final, full report and the updated appendix documents will be available on our website at www.pwc.com/chinasemicon.
IC design in China

Integrated circuit (IC) design continues to be the fastest growing segment of China’s semiconductor industry. It grew by 33% in 2013 to reach record revenues of US$13.2bn. During the ten years from 2003 through 2013 China’s IC design (fabless) industry has grown at a 37.6% CAGR from US$541mn to over US$13bn. Measured in US dollars, IC design sector revenue contributed more than 37% to China’s semiconductor industry revenue growth in 2013 and has grown to represent 20% of China’s total semiconductor industry. In addition, China’s IC design sector was responsible for about 39% of the output of China’s IC manufacturing (wafer foundry) sector and 11% of the output of China’s IC packaging and testing sector. In total, China’s IC design sector was responsible for about 29% of China’s semiconductor industry revenue in 2013.

During the last ten years China’s IC design industry has grown from representing just 0.4% of the worldwide IC market and 2.5% of the worldwide fabless IC industry in...
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Figure 14: Number of IC design enterprises in China, 1990-2013

![Bar chart showing the number of IC design enterprises in China from 1990 to 2013](image)

Source: CCID

2003 to representing almost 5% of the worldwide IC market and 17% of the worldwide fabless IC industry in 2013.

China’s IC design industry remains somewhat less concentrated than the worldwide industry. China’s 2014 top ten IC design companies accounted for 43% (US$5.6bn) of China’s 2013 IC design revenues while the worldwide top ten fabless semiconductor companies accounted for 65% of worldwide 2013 fabless IC revenues.

For most of the same reasons discussed in the 2012 update (growth of China’s local electronic equipment manufacturers, increasing need for IT infrastructure from government, continuing improvement of cost and performance, low gross margins, high agility in terms of product cycles and volumes and favorable government industrial policy environment), CCID’s latest forecast is for China’s IC design sector industry to grow by a 21.9% CAGR over the next three years to reach US$23.8bn by 2016. If this forecast is realized, China’s IC design sector would represent almost 22% of worldwide fabless semiconductor revenues and slightly more than 5% of the worldwide IC market.

According to CCID, the number of China’s IC design enterprises increased from 518 in 2012 to 583 by the end of 2013. That increase of 65 additional IC design enterprises during 2013 is by far the largest net increase in the last ten years. However, it has been exceeded at least three times in China’s earlier semiconductor history by the reported increase of 111, 189 and 74 IC design enterprises in 2001, 2002 and 2003. There is some consideration that this increase is not a measure of new design enterprises established in 2013, but rather it is a measure of new design enterprises counted and reported by CCID in 2013. Regardless, it is relatively certain that the number
Employment growth in China’s IC design sector increased with the significant addition of IC design enterprises in 2013.

Of the 583 IC design enterprises reported at the end of 2013 as many as 240 could be the design or research and development (R&D) units or activities of foreign invested or subsidiary multinational companies (MNC). Of this group, PwC analysis has identified over 238 participants. The group is spread across the more than 280 multinational semiconductor companies and the 100 largest semiconductor-consuming OEM/ODMs identified in the Gartner market share databases. Over the past ten years this group has grown and become a bit more concentrated among the smaller companies. It includes the Chinese design activities of 16 of the top 25 semiconductor companies and 17 of the top 25 semiconductor consuming OEM/ODMs.

Employment growth in China’s IC design sector increased with the significant addition of IC design enterprises in 2013. The total number of employees in the IC design sector increased by 14% in 2013 to about 128,000 with the distribution shifting slightly to the larger companies with more than 500 employees. This relative stability in employee density, resulting from the 12.5% increase in the number of enterprises and 14% increase in the number of employees, along with a significant, 33% increase in US dollar revenue, resulted in a slight 1.2% increase in the average number of employees per enterprise and a noteworthy 17% increase in average sales per employee productivity to US$103,000. As discussed in the 2012 update, the only relevant comparison of company employee productivity we have been able to make is of the nine
Chinese fabless companies that are included in the Global Semiconductor Alliance (GSA) Global Financials Report for 2013. The average 2013 sales per employee productivity of those nine Chinese fabless companies was US$236,000, which was a surprising 23% lower than a similar 2012 average and only 40% of the GSA report’s average of US$594,400 for 171 worldwide fabless companies. Six of the eight Chinese fabless companies reported in 2012 had an increase in employee productivity in 2013. The two remaining companies reported in 2012 had decreases in 2013 employee productivity because they had decreases in revenues with increases in employees. Both the one Chinese IC design company absent from the GSA report for 2013, Spreadtrum Communications, and the one added to the GSA report for 2013, Montage Technology, had above-average employee productivity; but because of its much larger relative size, the absence of Spreadtrum caused the 2013 average of the nine GSA reported Chinese fabless companies to decline. Spreadtrum was absent from the GSA 2013 report because it was acquired by Tsinghua Unigroup during 2013.

China’s IC design industry continued to make some reportable qualitative improvements during 2013, including a modest further migration to finer design line widths. According to CCID and CSIA, the number of design enterprises with design capabilities equal to or less than 0.25 microns increased by 14% in 2013 to represent slightly more than 45% of IC design enterprises, up from slightly less than 45% in 2012 and 43% in 2011. Seventy-one (71) of these enterprises had design capabilities for equal to or less than 90 nanometers, ten more than in 2012, and several have developed 40 nanometer phone chips.
During the last ten years, the distribution of China’s IC design industry’s technology capabilities has become somewhat more divided between mature and advanced. The share of China’s IC design enterprises with capabilities of equal to or greater than 0.35 microns has increased from 34% in 2003 to 54% in 2013; and the share with capabilities between 0.11 to 0.25 microns has decreased from 65% in 2003 to 33% in 2013, while the share with capabilities of equal to or less than 0.09 microns has grown to 13% in 2013.

During the last ten years, the composition of China’s IC design industry experienced considerable change as the sector’s revenue grew by more than 24 fold: US$541mn to US$13,150mn. In our initial report, we included a table (Table 4) that detailed “a select number of the fabless and contract IC design companies that appear to have competitive product lines and documented design wins—no company’s (2003) revenue exceeded US$74mn.” Of the eighteen companies included in that table only one, Datang Microelectronics, continued on to be part of a new merged company, Datang Semiconductor Design, that was one of China’s 2014 top five IC design companies.

Datang Semiconductor Design, which was created from the 2013 merger of Datang Microelectronics and Leadcore Technology, was ranked fourth by the CSIA among China’s 2014 top IC design companies based upon reported 2013 revenues of US$395mn. The other 2014 top five IC design companies only became recognized during the past decade.

HiSilicon Technologies, which was ranked first with 2013 reported revenues of US$2,120mn, was the former chip R&D center of the Huawei Company that was spun out in 2005. HiSilicon, which has considerable experience in telecom ASIC device R&D with capabilities of designing at the 0.11µm technology node, rapidly rose to rank first among China’s IC design companies by 2007, a position it has maintained since then. A significant portion of its reported revenues are earned from servicing its parent, Huawei Company.

Spreadtrum Communications, which was ranked second, with reported 2013 revenues of US$1,013mn, was first reported in our 2006 update with 2004 revenues of US$16mn. It has maintained a sporadic, but overall fast growth for many years with vision and vitality in the development and marketing of mobile chipset platforms for smartphones, feature phones and other consumer electronics products, supporting 2G, 3G and 4G wireless communications standards. Spreadtrum holds a sizable market share in GSM/GPRS baseband chips and is making headway in the TD-SCDMA baseband segment. Spreadtrum, along with RDA Microelectronics, was recently acquired by Tsinghua Unigroup Ltd., an operating subsidiary of Tsinghua Holdings Co., Ltd., a solely state-owned limited liability corporation funded by Tsinghua University in China.

RDA Microelectronics, which was ranked third with reported 2013 revenues of US$455mn, was first reported in our 2009 update with 2007 revenues of US$14mn. RDA is China’s RF IC leader. The company, which shipped its first product in 2005, researches, designs, develops, produces and sells radio frequency chips, power amplifiers, transceivers, front-end modules and mixed-signal system chips domestically and internationally. RDA Microelectronics also offers technical advisory services. RDA was acquired by Tsinghua Unigroup Ltd. on July 19, 2014.

Beijing Nari Zhixin Microelectronics Technology (Beijing Nari Smart Chip (or IP Core) Microelectronics Co., Ltd.), which ranked fifth with reported 2013 revenues of US$350mn, is being reported for the first time in this 2014 update.
update. NARI IP Core is the member of the NARI Group mainly engaged in chip devices, terminals, applications and design, development, production and sales and engineering services of integration solutions. NARI Group Corporation (NARI) is the largest whole set supplier of electric power equipment in China and is an active player in the global power industry. NARI is dedicated to providing technologies, products, services and total solutions for customers in other fields such as industrial control, energy and railway transportation. It is the only domestic power system company engaged in IC design. After four years of development, NARI IP Core has a team of more than 300, an automated chip production plant of 10,000 square meters, capabilities of advanced integrated circuit design at the 65 and 55 nm technology nodes, analysis, testing, custom chip design and services. Since 2010, NARI IP Core has successfully tapped out 21 SOC (system on a chip) chips (of which 10 models were tapped out in 2013) and 50 ICs of various types with strategic planning for four product lines: security; hosting; identification; and communications based on the field of intelligent electricity and radiating to other industries and fields.

Three other companies from the eighteen in our original report table continue on to be reported among China’s 2014 top ten IC design companies. Hangzhou Silan Microelectronics was ranked sixth, with 2013 reported revenues of US$293mn; Beijing Vimicro was ranked ninth, with reported revenues of US$250mn; and CEC Huada Electronic Design was ranked tenth, with reported revenues of US$171mn. A different company, Shenzhen ZTE Microelectronics Technology, from the eighteen in our original report, is reported by CCID Consulting to be tenth among China’s IC design companies with 2013 revenues of US$249mn. The remaining two of China’s 2014 top ten IC design companies that only became recognized during the past decade were: China I.C. Design, ranked seventh, with reported revenues of US$291mn, was first reported in our 2005 update with 2004 revenues of US$55mn; and Galaxycore ranked eighth, with reported revenues of US$275mn, first reported in our 2011 update, with 2009 revenues or US$62mn.

Of the eighteen companies included in our original report’s Table 4: Select Chinese fabless and contract IC design companies, 11 companies, including the five described above, continue to be recognized and reported among our table of Major Chinese semiconductor companies by revenue, with 2013 revenue exceeding US$61mn. The remaining seven companies have completely disappeared from view.
Chinese semiconductor companies

Table 4 lists the top 50 Chinese semiconductor companies that had the largest revenues in 2013. By definition, the companies on the list are the largest indigenous Chinese companies that design, manufacture (or have manufactured, the legal term for outsourcing), market and sell semiconductor devices. Therefore, neither foundries nor packaging and testing companies are included on the list. They, along with foreign semiconductor companies manufacturing in China, are included in a table later on in our report.

The threshold for inclusion in this 2013 listing has increased to US$52mn, up 4% from the US$50mn used for the 2012 listing. Five companies qualified for inclusion on the 2013 listing for the first time, and one returned after a year’s absence. They include three IC design companies, two discrete LED companies and one returning IDM (integrated device manufacturer). One of the new IC design companies was the result of a merger of two previously listed companies. The combined reported dollar revenues of the continuing 47 of these top 50 Chinese semiconductor companies increased by 39.2% in 2013, which is much higher than the 16.7% increase reported by China’s total semiconductor industry. During 2013, these top 50 companies accounted for a record 16% of China’s total semiconductor industry revenues. They accounted for 56% of China’s IC design (fabless) revenues, but only 11% of discrete revenues and 8% of IDM and foundry revenues.

During the past ten years, our table listing of the top Chinese semiconductor companies has grown from 26 companies with average revenue of US$39mn first listed in the 2005 update to 50 companies with average revenue of US$226mn listed in this 2014 update. The revenue of the largest listed company increased more than twenty times from US$93mn in 2004 to US$2,120mn in 2013, while that of the smallest listed company increased three and a half times from US$15mn to US$52mn. Only two of the current top ten Chinese semiconductor companies, Datang Semiconductor Design and Hangzhou Silan Microelectronics, were among the top Chinese semiconductor companies listed in the 2005 update. Nine other of the companies listed in the 2005 update are among the remaining companies in the current listing of top Chinese semiconductor companies. Tianjin Zhonghuan Semiconductor Co., Ltd., which had been listed in the 2005 update and subsequent updates through the 2013 update, was not included in the listing of top Chinese semiconductor companies as it was determined that the majority of its revenues were semiconductor materials business revenues and its semiconductor device business revenues did not meet the threshold for inclusion.

### Table 4: Major Chinese semiconductor companies by revenue, 2012

<table>
<thead>
<tr>
<th>Name of company</th>
<th>Rank</th>
<th>Sales revenue (RMB:100mn)</th>
<th>Revenue (US$100mn)</th>
<th>Change</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>HiSilicon Technologies Co., Ltd.</td>
<td>1</td>
<td>74.19 130.40</td>
<td>1178 2,120</td>
<td>75.8%</td>
<td></td>
</tr>
<tr>
<td>Spreadtrum Communications Inc.</td>
<td>2</td>
<td>43.83 62.30</td>
<td>696 1,013</td>
<td>42.1%</td>
<td></td>
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<tr>
<td>RDA Microelectronics, Inc.</td>
<td>3</td>
<td>24.69 28.00</td>
<td>392 455</td>
<td>13.4%</td>
<td></td>
</tr>
<tr>
<td>Datang Semiconductor Design Co., Ltd.</td>
<td>4</td>
<td>18.92 24.00</td>
<td>300 390</td>
<td>26.8%</td>
<td></td>
</tr>
<tr>
<td>Beijing Nari Smart Chip Microelectronics Co., Ltd.</td>
<td>5</td>
<td>16.40 16.00</td>
<td>260 348</td>
<td>30.5%</td>
<td></td>
</tr>
<tr>
<td>Sanan Optoelectronics</td>
<td>6</td>
<td>19.70 20.05</td>
<td>313 326</td>
<td>1.8%</td>
<td></td>
</tr>
<tr>
<td>No. 55 Research Institute of China Electronics Technology Group Corporation</td>
<td>7</td>
<td>9.40 19.60</td>
<td>149 319</td>
<td>108.5%</td>
<td></td>
</tr>
<tr>
<td>MLS Co., Ltd.</td>
<td>8</td>
<td>12.64 18.00</td>
<td>201 293</td>
<td>42.4%</td>
<td></td>
</tr>
<tr>
<td>Hangzhou Silan Microelectronics Co., Ltd.</td>
<td>9</td>
<td>11.80 16.80</td>
<td>187 273</td>
<td>42.4%</td>
<td></td>
</tr>
<tr>
<td>Galaxycore Inc.</td>
<td>10</td>
<td>4.00  6.00</td>
<td>20  30</td>
<td>50.0%</td>
<td></td>
</tr>
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</table>

○ Design (Fabless) ▲ Discrete (LED) ▼ IDM ▲ Discrete
<table>
<thead>
<tr>
<th>Name of company</th>
<th>Rank 12</th>
<th>Rank 2013</th>
<th>Sales revenue (RMB:100mn)</th>
<th>Change</th>
<th>Sector</th>
<th>Revenue (US$100mn)</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xi'an Microelectronics Technology Institute</td>
<td>52</td>
<td>11</td>
<td>2.16</td>
<td>15.90</td>
<td>635.4%</td>
<td>34</td>
<td>259</td>
</tr>
<tr>
<td>Beijing Vimicro Co., Ltd.</td>
<td>12</td>
<td>12</td>
<td>11.00</td>
<td>15.40</td>
<td>40.0%</td>
<td>175</td>
<td>250</td>
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<tr>
<td>Shenzhen ZTE Microelectronics Technology Co., Ltd.</td>
<td>10</td>
<td>13</td>
<td>11.50</td>
<td>15.32</td>
<td>33.2%</td>
<td>183</td>
<td>249</td>
</tr>
<tr>
<td>Fuzhou Rockchip Electronics Co. Ltd.</td>
<td>23</td>
<td>14</td>
<td>7.88</td>
<td>15.07</td>
<td>91.4%</td>
<td>125</td>
<td>245</td>
</tr>
<tr>
<td>Jilin Sino Microelectronics Co., Ltd.</td>
<td>14</td>
<td>15</td>
<td>10.55</td>
<td>12.50</td>
<td>18.4%</td>
<td>168</td>
<td>203</td>
</tr>
<tr>
<td>Shenzhen Netcom Electronics Co., Ltd.</td>
<td>17</td>
<td>16</td>
<td>9.37</td>
<td>12.19</td>
<td>33.2%</td>
<td>149</td>
<td>198</td>
</tr>
<tr>
<td>Allwinner Technology</td>
<td>13</td>
<td>17</td>
<td>10.58</td>
<td>11.68</td>
<td>10.4%</td>
<td>168</td>
<td>190</td>
</tr>
<tr>
<td>Elec-Tech International Co., Ltd.</td>
<td>15</td>
<td>18</td>
<td>10.27</td>
<td>10.52</td>
<td>2.4%</td>
<td>163</td>
<td>171</td>
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<tr>
<td>CEC Huada Electronics Design Co., Ltd.</td>
<td>18</td>
<td>19</td>
<td>9.36</td>
<td>10.50</td>
<td>12.2%</td>
<td>149</td>
<td>171</td>
</tr>
<tr>
<td>Wuxi China Resources Huaian Microelectronics Co., Ltd.</td>
<td>19</td>
<td>20</td>
<td>8.68</td>
<td>9.59</td>
<td>10.5%</td>
<td>138</td>
<td>171</td>
</tr>
<tr>
<td>Foshan Nationstar Optoelectronics</td>
<td>21</td>
<td>21</td>
<td>9.00</td>
<td>9.00</td>
<td>0.0%</td>
<td>143</td>
<td>146</td>
</tr>
<tr>
<td>Suzhou Good-Ark Electronics Co., Ltd.</td>
<td>31</td>
<td>22</td>
<td>8.07</td>
<td>8.25</td>
<td>2.2%</td>
<td>128</td>
<td>134</td>
</tr>
<tr>
<td>Wuxi China Resource Semico Co., Ltd.</td>
<td>27</td>
<td>26</td>
<td>6.68</td>
<td>6.12</td>
<td>-8.9%</td>
<td>100</td>
<td>112</td>
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<tr>
<td>Shandong Inespur Huaguang Optoelectronics Co., Ltd.</td>
<td>32</td>
<td>24</td>
<td>6.00</td>
<td>8.00</td>
<td>33.3%</td>
<td>95</td>
<td>130</td>
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<td>Shanghai Fudan Microelectronics Co., Ltd.</td>
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<td>25</td>
<td>6.74</td>
<td>7.89</td>
<td>17.1%</td>
<td>107</td>
<td>128</td>
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<tr>
<td>GigaDevice Semiconductor</td>
<td>29</td>
<td>26</td>
<td>6.11</td>
<td>7.87</td>
<td>28.8%</td>
<td>97</td>
<td>128</td>
</tr>
<tr>
<td>Shenzhen Jufei Optoelectronics Co., Ltd.</td>
<td>22</td>
<td>27</td>
<td>7.50</td>
<td></td>
<td></td>
<td>122</td>
<td></td>
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<tr>
<td>Xiamen Hualian Electronics Co., Ltd.</td>
<td>25</td>
<td>28</td>
<td>6.60</td>
<td>7.29</td>
<td>10.5%</td>
<td>105</td>
<td>119</td>
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<tr>
<td>Montage Technology Group Ltd.</td>
<td>34</td>
<td>29</td>
<td>4.93</td>
<td>6.82</td>
<td>38.3%</td>
<td>78</td>
<td>111</td>
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<tr>
<td>Shanghai Huahong IC Co., Ltd.</td>
<td>22</td>
<td>30</td>
<td>6.68</td>
<td>5.77</td>
<td>-13.3%</td>
<td>106</td>
<td>110</td>
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<tr>
<td>Fosham Blue Rocket Electronics Co., Ltd.</td>
<td>30</td>
<td>31</td>
<td>6.07</td>
<td>6.71</td>
<td>10.5%</td>
<td>96</td>
<td>109</td>
</tr>
<tr>
<td>Shanghai Epilight Technology Co., Ltd.</td>
<td>35</td>
<td>32</td>
<td>4.70</td>
<td>6.20</td>
<td>31.9%</td>
<td>75</td>
<td>101</td>
</tr>
<tr>
<td>Shenzhen Refond Optoelectronics Co., Ltd.</td>
<td>33</td>
<td>33</td>
<td>5.00</td>
<td>6.82</td>
<td>36.4%</td>
<td>79</td>
<td>111</td>
</tr>
<tr>
<td>Beijing Huadazhibao Electronic Systems Co., Ltd.</td>
<td>41</td>
<td>34</td>
<td>4.00</td>
<td>5.20</td>
<td>30.1%</td>
<td>63</td>
<td>85</td>
</tr>
<tr>
<td>Guangzhou Hongli Opto-Electronics</td>
<td>40</td>
<td>35</td>
<td>4.90</td>
<td>5.00</td>
<td>2.1%</td>
<td>70</td>
<td>81</td>
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<td>Changelight Co., Ltd.</td>
<td>44</td>
<td>36</td>
<td>3.70</td>
<td>4.90</td>
<td>32.4%</td>
<td>59</td>
<td>80</td>
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<td>Chengdu Yaguan Electronic Co., Ltd.</td>
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<td>37</td>
<td>4.22</td>
<td>4.68</td>
<td>10.5%</td>
<td>67</td>
<td>76</td>
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<td>Shantou Huashan Electronic Device Co., Ltd.</td>
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<td>38</td>
<td>4.17</td>
<td>4.61</td>
<td>10.6%</td>
<td>66</td>
<td>75</td>
</tr>
<tr>
<td>China Electronics Science &amp; Technology Group Company No. 58 Institute</td>
<td>42</td>
<td>39</td>
<td>3.98</td>
<td>4.40</td>
<td>10.5%</td>
<td>63</td>
<td>72</td>
</tr>
<tr>
<td>Shenzhen State Micro Technology Co., Ltd. (SMIT)</td>
<td>9</td>
<td>40</td>
<td>4.47</td>
<td>4.37</td>
<td>-2.4%</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>Tongfang Microelectronics Company</td>
<td>48</td>
<td>41</td>
<td>3.32</td>
<td>4.32</td>
<td>30.0%</td>
<td>53</td>
<td>70</td>
</tr>
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<td>Nationz Technologies Inc.</td>
<td>43</td>
<td>42</td>
<td>4.28</td>
<td>4.31</td>
<td>0.7%</td>
<td>68</td>
<td>70</td>
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<tr>
<td>Silergy Semiconductor Technology( Hangzhou) Co., Ltd.</td>
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<td>43</td>
<td>4.31</td>
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<td></td>
<td>70</td>
<td></td>
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<td>Actions Semiconductor Co., Ltd.</td>
<td>47</td>
<td>44</td>
<td>3.40</td>
<td>4.24</td>
<td>24.7%</td>
<td>54</td>
<td>69</td>
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<tr>
<td>Aqualite LED Ltd.</td>
<td>45</td>
<td>45</td>
<td>3.10</td>
<td>3.90</td>
<td>25.8%</td>
<td>49</td>
<td>63</td>
</tr>
<tr>
<td>Forward Semiconductor Company</td>
<td>45</td>
<td>46</td>
<td>3.49</td>
<td>3.86</td>
<td>10.5%</td>
<td>55</td>
<td>63</td>
</tr>
<tr>
<td>Yangzhou JingLai Semiconductor (Group) Co., Ltd.</td>
<td>46</td>
<td>47</td>
<td>3.40</td>
<td>3.76</td>
<td>10.5%</td>
<td>54</td>
<td>61</td>
</tr>
<tr>
<td>ShenZhen Si Semiconductor Co., Ltd.</td>
<td>36</td>
<td>48</td>
<td>4.32</td>
<td>3.75</td>
<td>-13.2%</td>
<td>69</td>
<td>61</td>
</tr>
<tr>
<td>Beijing MXTronics Co., Ltd.</td>
<td>38</td>
<td>49</td>
<td>4.21</td>
<td>4.53</td>
<td>15.2%</td>
<td>67</td>
<td>77</td>
</tr>
<tr>
<td>Wuhan HC SemiTek Co., Ltd.</td>
<td>49</td>
<td>50</td>
<td>3.30</td>
<td>3.20</td>
<td>-3.0%</td>
<td>52</td>
<td>52</td>
</tr>
</tbody>
</table>

Source: CSIA, CCID, GSA, Gartner, PwC
**Interview**

**Rick Clemmer**  
President and CEO  
NXP Semiconductors NV

*NXP has been one of the ten largest suppliers to the China semiconductor market for eight of the last ten years. NXP has three manufacturing operations in China, including the first multinational established wafer fabrication enterprise.*

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**How has China impacted your company over the past ten years? What’s different about your company because of China?**

Well, our most significant growth engine has come out of China. It depends on how you define China. But if you define China as Greater China, including Taiwan, roughly half of our revenue comes from Greater China.

It’s a very significant market for us. One that we pay a lot of attention to and one that has been a significant growth driver for us. Over the last three years we’ve doubled our revenue in China.

On a growth basis, China, not including Taiwan, would probably be higher. It would be obviously a little lower of a percentage of our total revenue. But it would still be 36% to 38% that goes into China. I’m talking about shipments into China. The NXP value consumed in China could be even higher than 50%.

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**How has China impacted the semiconductor industry over the past ten years? What’s different about the industry because of China?**

The huge growth opportunity that has existed within China has been a major catalyst for the whole industry and the industry has taken advantage of that and participated in that.

Obviously, a number of goods produced in China get shipped to the rest of the world. But nevertheless, a great deal of the consumption actually takes place in China. And so it has a significant influence on the overall process.

If you include joint ventures, we have around 8,000 of our roughly 25,000 people located in China. So we don’t have a disproportionate share because we still have a lot of our manufacturing outside of China, even though we have a large assembly test plant in Guangdong.

We do have a large sales and sales support operation in China. And, yes, there are definitely designs or application-specific efforts that we make that are unique because of China. We do have some designs specifically for the Chinese market, a result of their unique standards.

It’s hard to say if China has had any impact on pricing. I think that semiconductor pricing is notorious. I mean, semiconductor companies are notorious for poor pricing in any case, so, I think maybe that China has potentially accelerated some of that. But I don’t know that I would say that it’s had an absolute impact because the industry doesn’t do a great job of pricing to value in any case.
How will China impact the semiconductor industry over the next five years or ten years?

That remains to be seen. I think that the consumption in China will continue to outgrow the rest of the market, to have a higher growth rate, so it will continue to have a larger share of consumption in the semiconductor industry as we go forward.

China will have a larger share of the semiconductor industry as well, so we’ll have significant influence associated with that. The reason I say it remains to be seen is, you know, clearly the participation or direction by the government could have an influence on what happens in the semiconductor industry in China.

I think that it truly remains to be seen over the next half decade to decade what impact China will have and I think that the worldwide semiconductor industry is aggressive enough on innovation that it can potentially continue to stay ahead of any of the requirements of the so-called local Chinese companies.

But I think Western companies, European and US companies, are going to have to figure out if there’s a different way to do business in China when you start to talk about a decade out as well.

I think there will be differences, but it all remains to be seen. We participate in China as a direct sales vehicle, as a manufacturing entity and as a joint venture. So we’re trying to be sure that we participate in China as a good Chinese citizen.

As I’ve said before, we’d like to be sure that we look as Chinese as possible in supporting our customers in China. And I think that will continue to be very important. The large number of manufacturing jobs that we have in China and the increasing number of design and engineering jobs we have in China are also important.

What factors influence, either enhance or limit, China’s participation and impact on the semiconductor industry and market?

Oh, I’m not sure I understand that completely to be quite candid. I think the free market is obviously a very significant contributing factor to the ability to create innovation and stay in a significant position. So I think the Chinese government has to be sure that they facilitate the free market so that ultimately they can ensure they have products that are serving worldwide customers in the most cost effective manner possible.

I think there’s always different debates and discussions. Whether it’s software standards or whether there are certain applications that have to be provided by a Chinese-owned company. But I think the bottom line is for the Chinese economy to continue to be as successful in end markets as it has been, it’s essential that they realize how important a free market system is and being able to facilitate that so they get the most creative and innovative technology.

We have not experienced or seen them doing anything that restricts that free market; just discussion around it and a lot of, if you will, noise about future actions and activities.
Well, what about this “almost” requirement for indigenous innovation as an example? Or value added content for government procurement?

Yes. That was my point. They’ll potentially end up with not the most creative innovation in their products if that’s a requirement associated with it because for some period of time, they won’t have the most advanced technology or the most advanced innovations.

So if they really want to be competitive in the markets and in their general economy, then they need to be in a position where they can participate in that and support that.

What challenges and opportunities will China represent for your company over the next five or ten years?

Well, I think, again, China will represent a significant growth opportunity. As I’ve mentioned, we’ve doubled our revenues over the last three years so we think there’s opportunity to grow at that same rate as we move forward for the next three years. I think that one thing that we have to be careful about is being sure that we’re very flexible as far as the way we do business.

We consider different capital structures, different ways of doing business. You know, we now have an equity investment in a Chinese public company and we sit on the Board. We have a couple of joint ventures. We just created a new design joint venture with Datang.

So, our intent is to ensure that we have the flexibility to do business in ways that lets us continue to participate in this significant growth opportunity in the Chinese market, ways that we think will present themselves over the next half decade to decade, which will give us an opportunity to be a leader.

What do you see is driving the growth opportunity over the next five or ten years? Do you think that China will continue to have a further increasing share of total electronic systems production or do you think it is primarily that China’s domestic consumption will drive the growth?

I think both will be a factor in their growth. I think there are areas, for example, in smart lighting, where the domestic consumption in China will represent a much more significant opportunity than any other market around the world. And then there’s other areas where they’ll continue to be effective in producing products that get consumed in other parts of the world.

I’m a big fan of the Chinese and what they’ve been able to do and what I think they can continue to do.

How has NXP contributed to local technology, academic and R&D development?

Well, we’ve increased our R&D activities in China significantly over the last five years and plan to continue to do that. We’ve worked with a number of universities in China relative to providing them core capability in microcontrollers as well as some other various areas.

And we actually offered awards and employment opportunities to some of the students in those areas. China, as I’ve already said, continues to be very significant and, frankly, we’d like to employ more Chinese.

I definitely expect the percentage of our total R&D expenditures that occur in China to grow. I don’t actually have the percentage off the top of my head, but I definitely expect that percentage to grow.

We’ve been instrumental in working with various organizations in China to put them at the forefront. Take, for example, mobile and card-based payments. If you look at payment cards, China is rolling out en masse Dual Interface EMV Cards that are a combination of Chip and Pin plus contactless payment. These cards are multi-purpose, being ready for use in mass transit as well as payment, and we have worked with China UnionPay and transportation authorities to make this a reality.

And that’s a perfect example of the success of the Chinese approach and their ability to decide what kind of technology needs to be deployed for payments, and then roll it out at a fraction of the time it took Europe and now the US. China learned from the European experience that Chip and Pin immediately massively reduced fraud while the contactless feature enables a much higher level of consumer user experience.

Has taking these steps made NXP a highly preferred employer for new Chinese university graduates?

I wouldn’t say that necessarily. I mean, we’re still not a household or a classroom name so I wouldn’t say that it necessarily has made us a preferred supplier. I think that we’re much better known than we were five or six years ago. And hopefully we’ll continue to become more familiar and well-known.
Has it made you a target for or source of recruiting by other Chinese semiconductor companies?

Yes, somewhat. I would say as much as anything else from other international semiconductor companies that have tried to basically go out and recruit some of our employees because of the activities they’ve been able to drive and their customer engagements.

What role did Chinese incentives play in your achieving this status?

They contributed somewhat early on, although I wouldn’t say that they’ve been a significant factor. That’s probably not fair either. I mean, we certainly have tax incentives on, for example, the joint venture that we just signed with Datang. So there are government incentives that play a role relative to our deployment associated with it.

What concerns do you have about how you will protect your and your customers’ IP deployed in your various ventures there?

Well, that’s always a concern. I think for us as a company we have to be sure that we run faster than the Chinese do. So I think staying ahead of them is one of the only ways to protect your IP such that it doesn’t have the same inherent value. But it’s something that is always a challenge and you have to be sure that it can be dealt with.

We don’t have our most advanced research in China. Most of our research in China is more customer-specific, taking our fundamental core technology and adapting it for Chinese customer use. So, from that side, the most advanced technology isn’t there at the current time, although we continue to put more and more advanced technology there all the time.

If you think back over the ten years to get to the status you now have in China, what have been your greatest challenges?

You know, I think the Chinese market is not that much different than the rest of the world’s semiconductor market. It’s all about having the right technology lined up for the right product.

So ensuring that you’ve got the technology that can meet the requirements of the customers in China, whether it’s for export—or ultimately now moving more towards the consumption side—is absolutely critical because if you can’t meet those requirements for customers then obviously you won’t be in a position to support them for an extended period of time. I don’t think that is any different between China and the rest of the world.

Are there any things that are different because it’s China?

Well, I think sometimes some of the customer requirements are potentially more demanding than they may be in the other parts of the world. But, you know, that’s kind of it. I don’t think there’s a lot of other things that are totally different, that represent a significant difference.

Do you have any Chinese competitors?

We have a very broad product portfolio. So there are some competitors in narrow ranges of our product portfolio, Chinese competitors. And clearly we try to watch those as closely as we can. It is hard to define when you look at Chinese companies whether they are new fabless design companies or Chinese IDMs because they’re pretty closely associated with their foundry partners as well. So I would say they are both in some cases.

I think over the coming years, there will be a number of them that will develop into very significant competitors.
Overall, 2013 was a second year of wafer fab capacity rationalization rather than growth for both China and the worldwide industry. During the past year, eleven new LED fabs and one discrete power fab started production in China with a combined nominal capacity of 52K 8”-equivalent wafer starts per month (WSpM), while twelve existing LED fabs, along with one discrete, one foundry IDM and one R&D fab, with a combined nominal capacity of 20K WSpM were decommissioned. The net result was that the number of fabs in production in China during 2013 decreased by three, to 160, while their net nominal capacity increased by about 2%. By comparison, the number of fabs in production worldwide decreased by one, for a net decrease in nominal capacity of less than 1%. Consequently, China’s share of worldwide fab capacity in 2013 increased slightly to 10.9%.

Most of China’s 2013 wafer fab capacity rationalization occurred among the O-S-D sector LED fabs. All of the twelve existing LED fabs that were decommissioned in 2013 were relatively small, 2-inch fabs with an average capacity of less than 1K 8”-equivalent WSpM. They were replaced by five larger 2-inch, three 4-inch, one 6-inch and one 8-inch LED fabs with an average capacity of almost 4K 8”-equivalent WSpM. As a result, although the number of China’s O-S-D LED production wafer fabs decreased by one during 2013, to 69, their average capacity increased from 2.7K 8”-equivalent WSPM in 2012 to 3.8K in 2013 and China’s total LED wafer fab capacity increased by more than 40% in 2013 to 262K 8’-equivalent WSpM.

China was also able to increase the effective utilization of its wafer fab capacity during the past year by more

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**Figure 17: China’s wafer fabrication capacity and share of worldwide capacity 2002-2013**

<table>
<thead>
<tr>
<th>Year</th>
<th>Capacity in thousands (K 8” WSpM)</th>
<th>Percent Share of Worldwide Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>0.5</td>
<td>1.5%</td>
</tr>
<tr>
<td>2003</td>
<td>3.2</td>
<td>3.2%</td>
</tr>
<tr>
<td>2004</td>
<td>6.3</td>
<td>6.3%</td>
</tr>
<tr>
<td>2005</td>
<td>6.9</td>
<td>6.9%</td>
</tr>
<tr>
<td>2006</td>
<td>7.4</td>
<td>7.4%</td>
</tr>
<tr>
<td>2007</td>
<td>7.3</td>
<td>7.3%</td>
</tr>
<tr>
<td>2008</td>
<td>8.7</td>
<td>8.7%</td>
</tr>
<tr>
<td>2009</td>
<td>9.7</td>
<td>9.7%</td>
</tr>
<tr>
<td>2010</td>
<td>10.5</td>
<td>10.5%</td>
</tr>
<tr>
<td>2011</td>
<td>10.8</td>
<td>10.8%</td>
</tr>
<tr>
<td>2012</td>
<td>10.7</td>
<td>10.7%</td>
</tr>
<tr>
<td>2013</td>
<td>10.9</td>
<td>10.9%</td>
</tr>
</tbody>
</table>

Notes: Capacity is in thousands of 8-inch equivalent wafer starts per month/Fully ramped. This is the maximum number of wafers in wafers per month that could be started each month if the fab were fully equipped as defined in the fab design specifications and if the equipment were fully utilized.
than 16% by further equipping and ramping production at existing fabs, as well as improving their overall utilization while worldwide effective fab utilization, increased by slightly more than 5%.

The overall relative composition of China’s wafer fab capacity changed moderately during 2013. Because China further increased its disproportionately large share (26%) of worldwide LED fab capacity while maintaining its 21% share of worldwide discrete fab capacity, it continued to have a much higher mix of smaller wafer size (150mm or less) and mature technology node (0.7µm or greater) fab capacity than worldwide. At the same time, its share of worldwide intermediate technology node (0.2 to 0.028µm) capacity increased to 15%, while its share of advanced technology node (28nm or less) remained at zero. During 2013 there were still no Chinese wafer fabs in production at the advanced technology node (28nm or less), although the number of worldwide fabs in production at that node increased from 46 to 61 and their aggregate capacity by 21%. Similarly, China’s mix of larger 300mm wafer size and leading-edge technology node fab capacity remained less than worldwide. Not one of the eleven additional 300mm fabs that started production during 2013 were in China. That relative composition is expected to change somewhat during the next year as 13 of the 38 new wafer fab under construction worldwide are in China, representing 21% of new committed capacity. The 13 include the Samsung Xi’an 300mm NAND Flash fab which, when it enters production in 2014, will become China’s largest and most advanced technology wafer fab. When all are in full production, China will have moved somewhat closer to having a representative mix of larger wafer size and advanced technology wafer fab capacity.

Foundry production continued to constitute the largest share of China’s wafer fab capacity in 2013 at 43% of total compared to the worldwide average of 27%. IDM production only constituted 24% of China’s wafer fab capacity, compared to 52% worldwide. That mix will only slightly change when all the committed fabs currently under construction are brought into production, with China’s foundry...
A decade of unprecedented growth | China’s impact on the semiconductor industry—2014 update

production decreasing to 42% and IDM production increasing to 28% of total compared to 28% and 52% worldwide.

The average capacity of China’s wafer fabs in production at the end of 2013 was 14.4K 8°-equivalent WSpM per wafer fab compared to the worldwide average of 19.6K. According to the SEMI World Fab Watch database, China had only one fab—S.K. Hynix C2—with a capacity of more than 300K 8° WSpM and two—Intel Fab 68 and TSM Fab 10 (Songjiang)—with a capacity of 100 to 200 K 8° WSpM, which together accounted for 23% of China’s total fab capacity. The remaining majority of China’s fab capacity was distributed:

8°-equivalent WSpM

<table>
<thead>
<tr>
<th>Capacity (K)</th>
<th>Fab Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 50K</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>≥ 10K</td>
<td>43</td>
<td>40%</td>
</tr>
<tr>
<td>≥ 1K</td>
<td>77</td>
<td>16%</td>
</tr>
<tr>
<td>&lt; 1K</td>
<td>26</td>
<td>1%</td>
</tr>
</tbody>
</table>

As several companies had more than one wafer fab in production in China by the end of 2013, the distribution of China’s wafer fab capacity by company was somewhat concentrated with the following ten companies (listed in order of 8°-equivalent WSpM capacity) accounting for 59% of China’s total wafer fab capacity.

- S.K. Hynix: 13%
- SMIC: 13%
- Hua Hong Grace: 6%
- Intel: 5%
- TSMC: 5%
- CR Micro: 5%
- Hua Li Microelectronics: 3%
- Hangzhou Silan Microelectronics: 3%
- XMC: 3%
- China Resources Huajing Microelectronics: 3%

Figure 18: Current wafer fab capacity comparison, China and worldwide

<table>
<thead>
<tr>
<th>Capacity in millions of 8°-equivalent wafer starts per month</th>
<th>Percentage share of capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>O-S-D</td>
</tr>
<tr>
<td>18</td>
<td>Foundry/Dedicated</td>
</tr>
<tr>
<td>12</td>
<td>Foundry/IDM</td>
</tr>
<tr>
<td>12</td>
<td>R&amp;D/MEMS</td>
</tr>
<tr>
<td>12</td>
<td>IDM</td>
</tr>
<tr>
<td>12</td>
<td>N/A &amp; EPI</td>
</tr>
</tbody>
</table>

China’s capacity is 2.3 million, or 10.9% of worldwide

Capacity in 1,000s 8°-equivalent wafer starts per month
WF probability ≥ 1.0

Source: SEMI Wafer Fab Watch, Feb. 2014
During the past ten years, from the end of 2003 through 2013, the number of wafer fabs in production in China has increased by 186% from 56 to 160 (for a 11.1% CAGR) while their capacity has increased by 314% (for a 15.3% CAGR). Over the same time period, China's share of worldwide wafer fabs in production has increased from 6.2% to 15% and share of worldwide wafer fab production capacity from 5.7% to 11%. Of the 160 wafer fabs in production in China at the end of 2013, 53 had started production before the end of 2003, representing 32% of China's 2013 capacity; 48 had started production between 2004 and 2008, representing 45% of 2013 capacity and 39 had started production between 2009 and 2011, representing a further 19% of 2013 capacity. Ten fabs, 2% of capacity, started production in 2012 and five fabs, 1% of capacity, started production in 2013, with the production start of five fabs, 1% of capacity not known. Wafer fab capacity also became less concentrated during the past ten years. The top five companies only accounted for 42% of China’s capacity in 2013, down from 68% in 2003. Based upon installed wafer fab production capacity of 8”-equivalent wafer starts per month (WSpM), only one of the top five companies in 2003, SMIC, was among the top five in 2013. SMIC was ranked first in WSpM capacity in 2003, with 39% of China’s total, followed by Grace, Hua Hong NEC, ASMC and CSMC in order of capacity. Last year, S.K. Hynix was ranked first with 13.2% of China’s 2013 WSpM capacity, followed by SMIC with 12.6%; Hua Hong Grace with 6.3%; Intel with 5.1% and TSMC with 4.8%.
We asked a number of industry executives about China’s impact on the semiconductor industry overall and on their company in particular. Below are the comments the Chairman and CEO of Jiangsu Electronics Technology Co., Ltd. (JCET) shared with us.

There are three major factors that positively impact the development of JCET.

Mobile communication and electronics, including cell phones, tablets and other mobile terminals, have become the largest market for consumer electronics in recent years. Specifically, mobile phones, which have reached almost 18 billion in 2013, have been and will be the most important application for a long period of time. When looking at the mobile phone market evolution very closely, the “high-end” Apple and Samsung smart phones are reaching the market saturation stage; the basic “feature” phones are shrinking rapidly; and the real high growth is coming from “mid/low-end” smart phones. Currently, this high growth “mid/low-end” smart phone market is dominated by Chinese brands such as Huawei, Lenovo, ZTE, Coolpad and, most recently, Xiaomi. The tablet market is showing a very similar trend for the Chinese manufacturers as well. These market trends and developments have provided huge opportunities for the Chinese domestic IC design houses to grow, and it’s no surprise that some of them have been enjoying the fastest growth in past few years.

JCET is the largest domestic OSAT (outsourced semiconductor assembly and test) in China with annual revenues of US$850mn in 2013. Chinese domestic IC design houses are a major customer base for JCET, and JCET is dedicated to providing full support for the fast growth of these largest Chinese domestic IC design houses. JCET is also becoming the main packaging and test supplier for most of the top Chinese IC design houses and their fast growth in the Chinese market has been one of the major driving forces for the development of JCET.
In 2013, the size of the worldwide semiconductor industry was slightly over US$300bn, and statistics showed that China’s imported semiconductors accounted for more than US$200bn. That number was higher than the petroleum products China imported for the year. Semiconductors were the single largest imported product for China. The critical applications of semiconductors for the entire electronic industry and the heavy reliance on the import has alerted Chinese central and local governments to realize the importance of the domestic semiconductor industry, prompting many suggestions, proposals and government policies aiming to enhance the development of the domestic semiconductor industry at all levels. As the largest domestic IC OSAT company in China, JCET is well positioned to support the upcoming growth of the entire Chinese semiconductor industry.

JCET, with semiconductor assembling and test facilities based on China’s Great Yangtze River Delta, one of the most advanced and development regions in China, has been aggressively focusing on large scale and cost effective manufacturing. More importantly, it is the strategy and heavy investment in advanced technologies that have brought the steady growth of JCET in the long run. Currently, JCET has two worldwide IP technologies, Cu Pillar Bumping and Flip Chip, and MIS (Molded Interconnect System) high density substrate and packaging solution. With the unique advantages of high density and high performance, Cu Pillar Bumping and Flip Chip have become a mainstream technology for advanced semiconductors and packaging applications. MIS is also gaining in market applications at a very fast pace worldwide. The combination of large scale manufacturing and technology advancement has ensured that JCET supports the development of IC packaging applications in both China and worldwide.
Packaging, assembly and test capacity

Semiconductor packaging, assembly and test (SPA&T) nominal capacity in China was modestly consolidated during 2013 while unit production was increased by more than 6%. During the past year, China reported the closure of five SPA&T facilities; including three Japanese IDMs, one US SATS (semiconductor assembly and test services) and one Chinese SATS facility; the addition of one existing, but previously not reported facility; the opening of three new facilities and the consolidation of a few others, resulting in a 2.5% decrease in net manufacturing floor space, but with a 1.1% increase in number of employees. During the same time, the number of SPA&T facilities in the rest of the world increased by seven, while their total manufacturing floor space fell by 1.4% and employee numbers fell by 2.6%. As of the end of 2013, China had 116 SPA&T facilities in operation, a decrease from an adjusted total of 118 in 2011. These 116 facilities represent 21% of the total number of worldwide SPA&T facilities, more than 27% of worldwide SPA&T manufacturing floor space, and 24% of reported worldwide SPA&T employees.

Although China’s manufacturing floor space—a proxy for potential manufacturing capacity—decreased at a slightly greater rate (2.5%) than worldwide (1.4%) during 2013, it still represented 27.4% of worldwide SPA&T manufacturing floor space. As a result, China’s SPA&T facilities continued to rank first in share of SPA&T manufacturing floor space for the fifth year, noticeably ahead of Taiwan (at almost 20%) and Japan (at 11%). China’s SPA&T facilities also ranked first in number of reported employees, with 24% of worldwide employees at the end of 2013, ahead of Taiwan (19%) and Malaysia (17%).

At the end of 2013 China had five of the 18 planned new worldwide SPA&T facilities which represented almost 90% of the reported planned manufacturing floor space. All of the new planned worldwide SPA&T facilities are SATS facilities, with eight in Taiwan, five in China and three in South Korea. At the end of 2013, there were no new IDM SPA&T facilities planned worldwide.

Figure 20: Comparison of China and all remaining countries’ SPA&T resources, 2013

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>Rest of world</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of facilities</td>
<td>20.8%</td>
<td>79.2%</td>
</tr>
<tr>
<td>Number of employees</td>
<td>23.9%</td>
<td>76.1%</td>
</tr>
<tr>
<td>Amount of floor space</td>
<td>27.4%</td>
<td>72.6%</td>
</tr>
<tr>
<td>Value of production</td>
<td>40.8%</td>
<td>59.2%</td>
</tr>
</tbody>
</table>

Source: Gartner
The ownership of China’s SPA&T facilities changed noticeably during the past year, with the share of facilities owned by Japanese companies decreasing from 15% to 11%, while the share owned by Chinese companies decreased from 32% to 31%. This was offset by increases in the share belonging to companies from the US (22%), Taiwan (15%) and Singapore (5%), while the share belonging to companies from Korea (6%) remained unchanged.

China’s SPA&T capacity continues to be more concentrated in the SATS sector than that of other regions: 80% of China’s SPA&T manufacturing floor space and 64% of China’s SPA&T facilities were dedicated to the SATS sector in 2013 versus 58% and 54% for all other countries. Eight of the ten largest worldwide SATS companies had one or more facilities in China for a total of 19 out of the 83 top ten SATS facilities worldwide. These 19 facilities accounted for 32% of the top ten SATS manufacturing floor space worldwide. One of the ten largest worldwide SATS companies is a Chinese company, Jingsu Changjiang Electronics Technology (JCET), ranked sixth in 2013, and there is a second Chinese SATS company, Nantong Fujitsu Microelectronics (NFME), ranked 18th in 2013 within the top twenty. In total, there were 28 Chinese SATS companies with 36 existing facilities that accounted for 18% of worldwide SATS manufacturing floor space in 2013.

Packaging, assembly and test remains the largest of China’s semiconductor manufacturing activities when measured in terms of value added, production revenue, employees and manufacturing floor space, although this relationship is often missed because it is allocated between two separate industry sectors: the IC packaging and testing and the O-S-D sectors. The composite weighted average of China’s 2013 SPA&T production is now estimated to be about 58% of worldwide, up from a revised 52% in 2012.

During the past ten years, from the end of 2003 through 2013, the number of SPA&T facilities in production in China has increased by 51%, from 77 to 116 (for a 4.2% CAGR), while their capacity has increased by 175% (for a 10.6% CAGR). Over the same time period, China’s share of worldwide SPA&T facilities in production has increased from 17.7% to 20.8% and its share of worldwide SPA&T manufacturing floor space from 10.5% to 27.4%. During the past ten years China has added a disproportionate share of larger SPA&T facilities as the

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**Figure 21: Comparison of China and all remaining countries SATS share of SPA&T capacity, 2013**

<table>
<thead>
<tr>
<th></th>
<th>Captive packaging assembly and test</th>
<th>Semiconductor assembly and test services (SATS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of facilities</td>
<td>34.5%</td>
<td>65.5%</td>
</tr>
<tr>
<td>Amount of floor space</td>
<td>50.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Number of employees</td>
<td>20.0%</td>
<td>80.0%</td>
</tr>
<tr>
<td></td>
<td>41.9%</td>
<td>58.1%</td>
</tr>
<tr>
<td></td>
<td>31.6%</td>
<td>68.4%</td>
</tr>
<tr>
<td></td>
<td>45.7%</td>
<td>54.3%</td>
</tr>
</tbody>
</table>

Source: Gartner
average size of China’s SPA&T facility has increased from 108K to 197K square feet of manufacturing floor space while the worldwide average decreased from 181K to 150K. Of the 116 SPA&T facilities in existence in China at the end of 2013, 48 had started production before 2003, representing 36% of China’s 2013 capacity; 38 had started production between 2004 and 2008, representing 37% of 2013 capacity and seven had started production between 2009 and 2011, representing a further 8% of 2013 capacity. Three SPA&T facilities, 6% of capacity, started production in 2012 while the production start of 20 facilities, 13% of capacity, is not known. SPA&T capacity also became somewhat less concentrated during the past ten years. The top five companies only accounted for 33% of China’s capacity in 2013, down from 48% in 2003. Based upon reported manufacturing floor space capacity only two of the top five companies in 2003, ASE and STATS ChipPAC, were among the top five in 2013. ASE (including GAPT) was ranked first in manufacturing floor space capacity in 2003 with 22% of China’s total, followed by Intel, SDI, STATS ChipPAC, and Integrated Microelectronics in order of capacity. Last year, JCET/JCAP was ranked first with 9.5% of China’s 2013 SPA&T capacity, followed by Tanshui Huatian Technology with 8.3%; ASE with 7.0%; Chipmore with 4.7%; and STATS ChipPAC with 3.5%.

The top five companies only accounted for 33% of China’s capacity in 2013, down from 48% in 2003.
The Yangtze River Delta, or East China region, continues to have the heaviest concentration of China’s semiconductor industry. It accounted for 55% of China’s IC industry revenues in 2013, down from a peak of 71% in 2007 and 2008, and 57% in 2012. Of the 160 semiconductor wafer fabrication facilities in operation in China at the end of 2013, 84 are located in the East China region, representing 66% of China’s total wafer fabrication capacity, an increase from 79 facilities for 64% of capacity in 2011. Similarly, East China had 69 of China’s 116 SPA&T facilities in operation during 2013, representing 65% of China’s total SPA&T capacity. This was also an increase from 65 facilities for 62% of capacity in 2011. The majority of these plants are located in Shanghai, Suzhou and Wuxi. Four of China’s top ten IC design firms are also located in this region.

As a result of the continuing strong growth of IC design firms, the Pearl River Delta, or South China region, accounted for 15% of China’s IC industry revenue in 2013, up from 13% in 2012 and 9% in 2011. The two of China’s top ten IC design firms that are located in this area accounted for 42% of top ten revenues for 2013. The 24 SPA&T facilities that are located in this region accounted for 16% of China’s SPA&T capacity in 2013, down from 17% in 2011, while the number of wafer fabrication facilities in the region decreased by three, to 23, continuing to only represent 7% of China’s total wafer fabrication capacity. The majority of the region’s semiconductor manufacturing plants are located in Shenzhen, Dongguan and Zhuhai.

The four other regions of China accounted for the remaining 11% of the country’s IC industry revenues in 2013. Of China’s 160 semiconductor wafer fabrication facilities, ten are located in Northeast China, including Dalian and Jilin, representing 10% of China’s capacity; ten in Central China for 5% of capacity; four in Southwest China, including Chengdu, Chongqing and Leshan, for 3% of capacity and eight in Northwest China for 1% of capacity. Four of China’s 116 SPA&T facilities are located in Northwest China for 9% of China’s capacity; six in Southwest China for 6% of capacity and three in Northeast China for 0.3% of capacity.
During the past five years, there has been a noticeable shift in the regional location of China’s IC industry with South China and the four other regions gaining share and the East and North China regions decreasing share. China’s IC industry revenue from the four other regions of Central, Southwest, Northeast and Northwest China, increased by more than 750% in the last five years. It has grown from 3% of China’s total IC industry revenues in 2009 to 11% in 2013. Similarly, South China’s IC industry revenues increased by more than 360% during the same period and its share of China’s total IC industry revenues increased from 8% to 15%. While East China’s IC industry revenue doubled during those five years, its share of China’s total IC industry revenue decreased from 69% to 55%. Similarly, North China’s share decreased from 21% to 19% as its IC industry revenues only increased 82% during the past five years.

The above summary is not intended to simplify or dismiss the challenging geographic diversity and dispersion of China’s semiconductor industry that suppliers and customers need to address for success. There are at least 270 semiconductor wafer fabrication or packaging and testing plants currently in production spread across 20 different provinces in China. They span from Jilin in the North to Guangdong in the South and from Zhejiang in the East to Sichuan in the West, across an area of about 1,700,000 square miles (4,400,000 square kilometers).

Figure 22: China’s 2013 semiconductor manufacturing capacity by province and region

Source: SEMI, Gartner, PwC
Conclusion

This concludes the second section of this year’s update. Our next release will cover a number of topics, including China’s domestic OEM buying power, the top Chinese semiconductor manufacturers, the greater China market, semiconductor patents and IPOs, government incentives and growth scenarios. It will also feature an additional two interviews with industry executives. This will be followed by the final, full report, containing all three sections, updated as appropriate, an executive summary and a conclusion.

All sections of this year’s update, the full report and updated appendix will be available at www.pwc.com/chinasemicon.
PwC can help

If your company is facing challenges doing business in China, or you just want to have a deeper discussion about what’s happening in the market and how we can help, please reach out to one of the technology industry leaders listed here.

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